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A COMPARISON OF CHOPPED AND UNCHOPPED SILAGE STORED IN BUNKER SILOS

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Making silage from unchopped forage, one of the oldest methods of ensiling, has never gained wide acceptance in this country chiefly because satisfactory equipment for moving forage into a tower silo has not been available. The current use of horizontal and stack silos and the availability of suitable equipment has posed the question - is there any advantage in chopping forage for such silos if it can be readily moved to and from storage in an unchopped condition?

Numerous 'on the farm' observations have indicated that chopping is not necessary nor advantageous and that buck rakes will efficiently gather, haul, and store the unchopped forage in the silo. A series of experiments was begun in 1954 to compare chopped and unchopped hay crop forage as silage made in horizontal aboveground structures on the basis of storage losses, feeding value and convenience. Results of the work of the first season are contained in this report.

Experimental Procedure

The second cutting of a grass-clover mixture was stored, with no intentional wilting, in two 15' x 66' x 8' drive-through bunker silos. The crop yield was light due to dry weather. Forage for one silo was picked-up from the swath with a buck rake and placed on trucks having flat-bed dump bodies. This long forage was hauled to the silo and dumped from the trucks. Forage for the second silo was harvested simultaneously from the same fields with a windrow field chopper (1/4" theoretical length), hauled in dump trucks and dumped into the silo.

The filling operation required 5 days for the chopped, and 7 days for the unchopped forage. Rate of s toring the chopped forage was purposely retarded in order to approximate the rate of storing the unchopped forage. Both silos were packed continually with tractors during the filling operation and for a day following. Both silos were covered with a sheet of poly-vinyl chloride 54" x .008" joined with pressure sensitive (4" width) tape.1/ The plastic covers were weighted at the edges with pipe and sawdust.

1/ Minn. Mining Co. Tape #471. Mention of this company does not constitute an endorsement by the U. S. Department of Agriculture over other companies or products not mentioned.

All forage, silage and spoilage was weighed, sampled, and analyzed. Seepage was metered and analyzed for dry matter content.

Both bunkers were opened after 6 months of storage and fed out in a 100 day single cross over feeding trial. The experimental animals (16 milking cows) were fed a grain mixture according to production plus the experimental silage to the extent of appetite.

Results

Low crop yields retarded the rate of both harvesting methods. Harvesting and storing of the unchopped forage proceeded at a slower rate for two reasons. First, full loading of the buck-rake was slow and difficult to attain, largely because of the low yield, shortness of plant growth and low moisture content. Secondly, unless very well packed between loads, the forage was prone to tangle on the truck drive shafts. Removal of this tangled material caused numerous and excessive delays.

Removing the unchopped silage from storage required considerably more labor than did the chopped. Although an axe or rolling coulter jabber was used for making vertical cuts, the tangled condition of the long grass made removal of layers difficult. This condition also interfered with accurate separation of spoiled and good silage in the upper position.

Rather low efficiencies of nutrient preservation (compared to wilted silage in tower silos) marked both silages, (Table 1). Total storage losses of stored dry matter were 28.3 and 31.3% for the unchopped and chopped silages, respectively. These losses were caused largely by top spoilage and fermentation since seepage losses accounted for less than 1% of the total dry matter stored. A layer of top spoilage averaging 9 to 11" was common to both silages. This fact was regarded as evidence of little benefit from the covering used, since similar amounts were observed in an uncovered corn silage the previous year. It appeared that the small amount of air that leaked through the taped seams and along the silo walls was sufficient to cause spoilage. The spoilage in the unchopped and chopped silages accounted for 11.9 and 12.3%, respectively, of the total dry matter stored. Average density of all material in the silo just prior to opening was 44.5 lbs/cu. ft. for the unchopped and 49.6 lbs./cu. ft. for the chopped silage.

The chemical composition of the stored forages and the corresponding silages is presented in Table 1. It may be noted that the two forages were very similar in average composition when stored. Composition, as indicated by proximate analysis was also quite similar in the resulting silage. However, the higher pH value, higher content of butyric acid and ammoniacal nitrogen and lower content of lactic acid that characterized the unchopped silage, indicated that it was of poorer chemical quality than was the chopped silage.

Results of the feeding trial are presented in Table 2. Under the conditions of this experiment the chopped silage was of higher feeding

value than the unchopped. The cows fed the chopped silage consumed more silage dry matter, produced significantly more milk, and gained more live weight than did the cows on the unchopped silage.

Discussion

Apparent differences in efficiencies of nutrient preservation are probably within the range of experimental error, particularly since separation of good from spoiled silage was very difficult in the unchopped material.

The rather high losses reported here are not surprising when one considers the relatively large amount of surface area exposed and the ineffectiveness of the cover. The failure of the cover to prevent top spoilage does not necessarily mean that the material is unsuited for this use. Rather, it demonstrates that a cover so constructed or applied as to have small air leaks may be no better than no cover, if an appreciable storage period is involved. The seams of this cover appeared to be smooth and tight when originally made but later developed puckers in the tape probably caused by differentials in elasticity between the plastic and the tape. Some means of weighting the entire surface of the cover might tend to localize the effect of an air leak, otherwise the entire surface could be effected by one leak.

The silages as fed differed with respect to chemical quality, (pH, ammoniacal nitrogen, butyric acid and lactic acid) as well as length of cut. It is, therefore, not definitely known to what extent each of these differentials was contributing to the lower feeding value of the unchopped silage. However, it seems logical to assume that the lower chemical quality was the primary factor. It is postulated that compaction and air exclusion was more difficult with the long forage and that as a result a less desirable type of fermentation took place. This postulation is supported by the results of fundamental studies in small experimental silos. In these studies under controlled conditions it was found that by allowing air to infiltrate the silage, the fermentation process could be directed toward the production of more butyric acid and less lactic acid. This mechanism appears to have been acting in both silages but was more pronounced in the unchopped material. With forage of a higher moisture content, as is normal in first cutting forage, air exclusion should be more readily accomplished in both chopped and unchopped forage, and might eliminate these differences in chemical quality. It is also likely that the buck-rake could be more efficiently used in such forage. For these reasons the results presented should be considered as a progress report. An experiment utilizing a high moisture first cutting crop, but otherwise similar to this experiment, is now under way.

Summary

A direct comparison was made of the convenience, preservation efficiency, chemical quality, and feeding value of unchopped and chopped hay crop silage stored in bunker silos. Under the conditions of this experiment chopping was found to be advantageous with respect to all of

these criteria, excepting preservation efficiency which was similar in both silages. Higher chemical quality in the chopped material may be explained on the basis of more thorough air exclusion. The higher feeding value may be explained on the basis of the higher chemical quality and greater palatability. A plastic cover as used in this study was unsuccessful in preventing large losses from top spoilage.

Table 1.-Average composition of silages, as stored and removed, and percentages of stored nutrients preserved for feeding

	Percentage composition 1/				Percent of stored nutrients preserved for feeding	
	Forage stored		good silage as removed			
	unchopped	chopped	unchopped	chopped	unchopped	chopped
Dry Matter	29.1	28.7	25.0	24.0	71.1	68.7
Crude Protein	14.3	14.9	15.4	15.7	76.5	72.5
Ether Extract	3.9	4.1	3.3	3.9	59.2	64.9
Crude Fiber	27.5	27.5	28.7	29.8	74.3	74.4
N.F.E.	45.1	44.4	42.0	40.4	66.3	62.5
Ash	9.2	9.2	10.6	10.3	82.3	76.9
Sugar	4.8	4.6	0.4	0.3	5.2	5.0
Carotene	215.3	221.6	173.7	206.3	57.4	63.9
pH			5.18	4.77		
Ammon. Nitrogen			24.89	16.02		
Acetic Acid			1.71	2.07		
Propionic Acid			0.43	0.39		
Lactic Acid			0.95	1.84		
Butyric Acid			2.39	1.61		

1/ Ammonical nitrogen expressed as percentage of total nitrogen, carotene as ug/gram of dry matter, all other constituents, except pH, expressed as percentage of total dry matter.

Table 2.-Results of feeding trial

		Unchopped silage	Chopped silage
Live weight per cow:			
Initial	pounds	1,194	1,200
Average	pounds	1,191	1,216
Average gain per day	pounds	0.30	0.96
Milk Production[1]:			
Initial per cow per day	pounds	33.01	33.08
Average per cow per day	pounds	30.67[2]	33.49[2]
30 day decline	pounds	3.10	0.67
	percent	9.5	2.3
Feed dry matter consumed per cow per day:			
Silage	pounds	21.94	24.42
Concentrates	pounds	7.26	7.30
Total	pounds	29.20	31.72
Feed dry matter consumed per 100 pounds of live weight per day:			
Silage	pounds	1.842[3]	2.008[3]
Concentrates	pounds	0.610	0.600
Total	pounds	2.452	2.608
Ratio grain to milk		1:4.22	1:4.59

1/ Four percent fat corrected milk.
2/ Highly significant difference.
3/ Not quite significant at 5% level, f value = 4.46, f value required at 5% = 4.67